Platform Technology Division

SARAP Overview Briefing

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RWV TDA PAYOFFS, GOALS, & OBJECTIVES

Phase 2 (2005)

Attack / Cargo / Utility Payoffs

82%	91%	90%	Increase in Range
	or		
91%	66%	58%	Increase in Payload
5%	6%	6%	Increase in Max Cruise Speed
65%	65%	65%	Increase in Maneuverability/Agility
4%	11%	9%	Reduction in System Acquisition Cost
14%	21%	18%	Reduction in System O&S Cost
20%	20%	20%	Decrease in Major Accident Rate
30%	30%	30%	Increase in Probability of Survival
20%	20%	20%	Increase in Mission Reliability

RWV Subarea Goals

15%	Reduction in RWV Empty Wt Fraction
11%	Increase in Cruise Efficiency (ηL/D)
66%	Increase in Maneuverability/Agility
15%	Reduction in Development Time
14%	Reduction in RWV Flyaway Cost
35%	Reduction in RWV Maintenance Cost
50%	Reduction in Signature

Rotorcraft System

Weapons* | Human-Sys Interface* | **Rotary Wing Vehicle** | Sensors* | Propulsion & Power*

Technology Efforts / Objectives

Aeromechanics

- **40%** Red. in Vibratory Loads
- **12%** Reduction in Vehicle Adverse Aero Forces
- **16%** Increase in Max Rotor Blade Loading
- **6%** Increase in Helo Rotor Aerodynamic Efficiency
- **3%** Increase in Prop / Rotor Aerodynamic Efficiency
- **66%** Increase in Inherent Rotor Lag Damping
- **75%** Aeromechanics Prediction Effectiveness

Drive System

- **33%** Increase in Drive Sys Power-to-Weight
- **20%** Reduction in Drive Sys Operating Cost, \$/FH
- **20%** Reduction in Drive Sys Production Cost, \$/hp
- **15dB** Red. in Transmission Generated Noise

Structures

- **15% Reduction in (Structural Component Wt) / GW**
- **25% Red. in Structures Manufacturing, LH/lb**
- **25% Reduction in Structural Component Development Time**
- **30%** Red. in Dynamically Loaded Structure Stress Prediction Inaccuracy

Subsystems

- **50%** Reduction in 0.4-0.7 µm Visual Signature
- **50%** Reduction in 3-5 µm (IR Signature) / shp
- **50%** Reduction in 8-12 µm IR Signature
- **10%** Red. (Threat Protection Component Wt) / GW
- **30%** Reduction in Total Maintenance Labor
- **60%** Auto Detection of Critical Mechanical Component Failures

Flight Control

- **65%** Improvement in Platform Pointing & Flight Path Accuracy [Attack Only]
- **185%** Improved External Load HQ at Night [Cargo Only]
- **65%** Reduction in Probability Degraded HQ due to FCS Failure
- **CH 3** Improved HQ at Night, with Partial Actuator Authority
- **40%** Increase in Precision Maneuvering at Extreme Load Factors
- **35%** Reduction in FCS Flight Test Development Time

*Constant at 1994 Technology

RWSTD will Demo in FY01

RWV TDA PAYOFFS, GOALS, & OBJECTIVES

Phase 3 (2010)

Attack / Cargo / Utility Payoffs

137%	151%	146%	Increase in Range
	or		
144%	103%	89%	Increase in Payload
8%	10%	10%	Increase in Max Cruise Speed
100%	100%	100%	Increase in Maneuverability/Agility
8%	17%	16%	**Reduction in System Acquisition Cost**
20%	30%	26%	Reduction in System O&S Cost
30%	30%	30%	Decrease in Major Accident Rate
40%	40%	40%	Increase in Probability of Survival
30%	30%	30%	Increase in Mission Reliability

RWV Subarea Goals

22%	Reduction in RWV Empty Wt Fraction
20%	Increase in Cruise Efficiency (ηL/D)
112%	Increase in Maneuverability/Agility
25%	**Reduction in Development Time**
22%	**Reduction in RWV Flyaway Cost**
50%	Reduction in RWV Maintenance Cost
60%	Reduction in Signature

Rotorcraft System

*Weapons

*Human-Sys Interface

Rotary Wing Vehicle

*Sensors

*Propulsion & Power

Technology Efforts / Objectives

Aeromechanics

- 60% Red. in Vibratory Loads
- 20% Reduction in Vehicle Adverse Aero Forces
- 24% Increase in Max Rotor Blade Loading
- 10% Increase in Helo Rotor Aerodynamic Efficiency
- 4.5% Increase in Prop / Rotor Aerodynamic Efficiency
- 75% Decrease in Vehicle Acoustic Detection Range
- 100% Increase in Inherent Rotor Lag Damping
- 85% Aeromechanics Prediction Effectiveness

Drive System

- 40% Increase in Drive Sys Power-to-Weight
- 30% Reduction in Drive Sys Operating Cost, $/FH
- 30% Reduction in Drive Sys Production Cost, $/hp
- 15dB Red. in Transmission Generated Noise

Structures

- 25% Reduction in (Structural Component Wt) / GW
- 40% Red. in Structures Manufacturing, LH/lb
- 40% Reduction in Structural Component Development Time
- 50% Red. in Dynamically Loaded Structure Stress Prediction Inaccuracy

SARAP Goals

Subsystems

- 60% Reduction in 0.4-0.7 µm Visual Signature
- 60% Reduction in 3-5 µm (IR Signature) / shp
- 60% Reduction in 8-12 µm IR Signature
- 20% Red. (Threat Protection Component Wt) / GW
- 45% Reduction in Total Maintenance Labor
- 75% Auto Detection of Critical Mechanical Component Failures

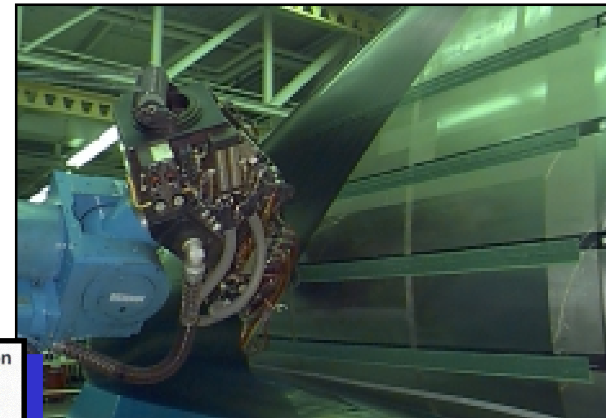
Flight Control

- 80% Improvement in Platform Pointing & Flight Path Accuracy [Attack Only]
- 225% Improved External Load HQ at Night [Cargo Only]
- 90% Reduction in Probability Degraded HQ due to FCS Failure
- CH 3 Improved HQ at Night, with Partial Actuator Authority
- 66% Increase in Precision Maneuvering at Extreme Load Factors
- 50% Reduction in FCS Flight Test Development Time

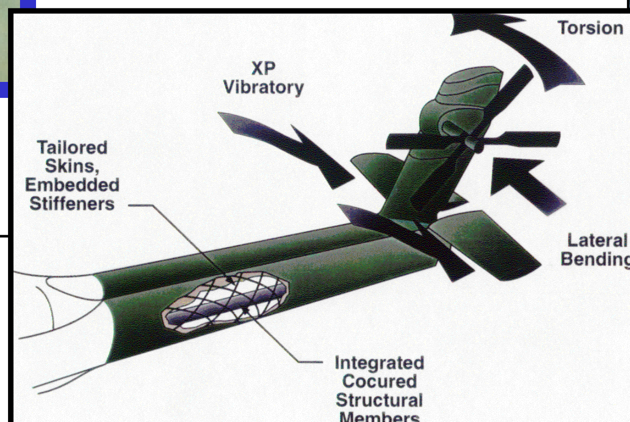
*Constant at 1994 Technology

Technology Challenges For Reduced Weight

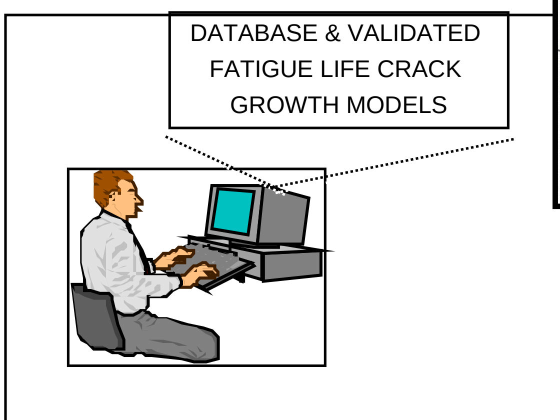
Structural Joining



Fiber Placement



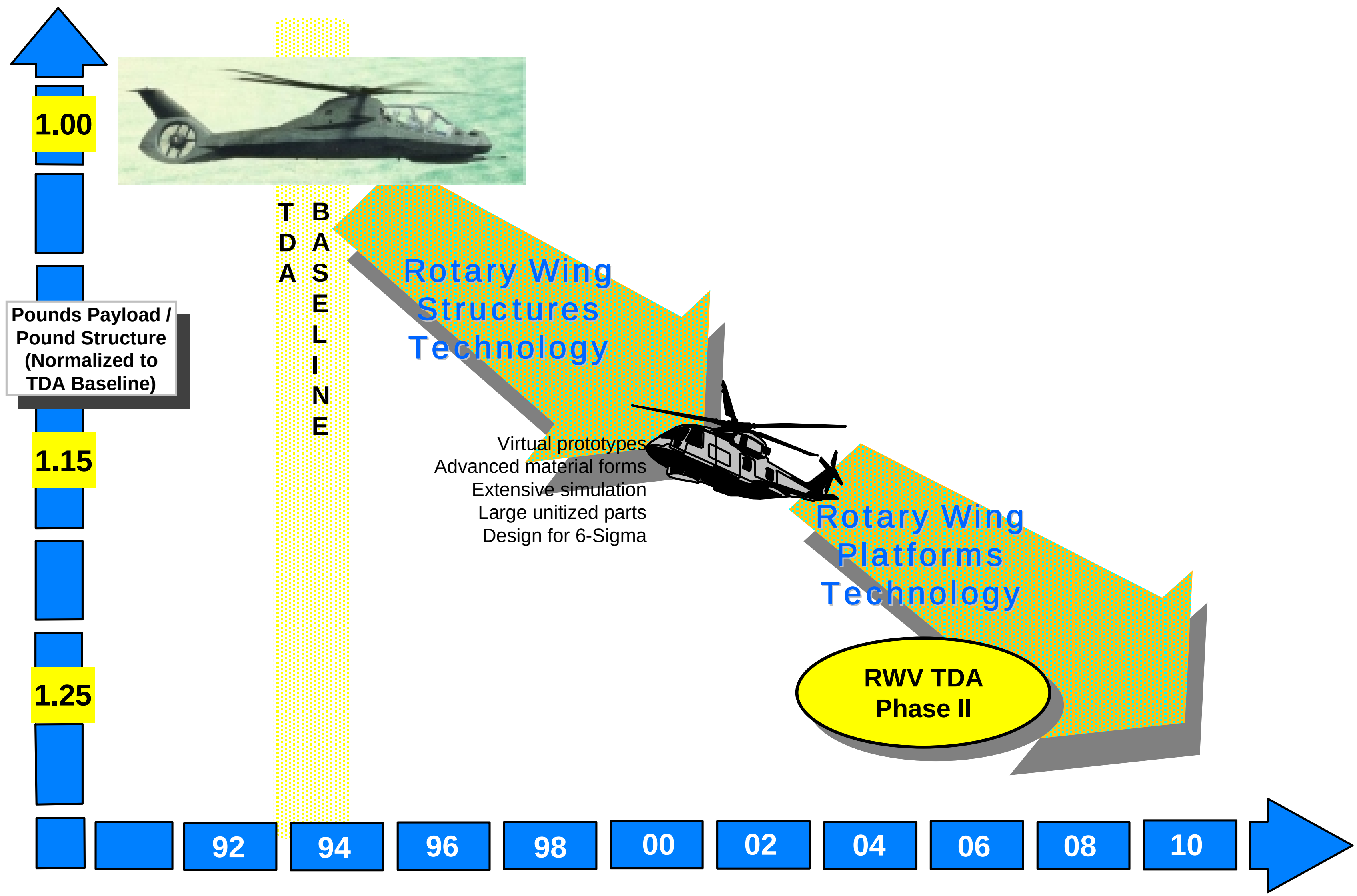
Tailored Structures



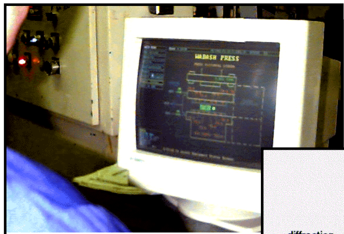
Accurate Loads/Stress Analyses

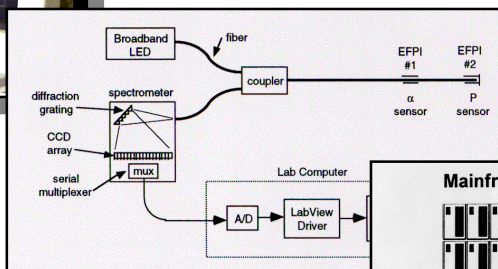
Efficient Crashworthy Structure

RWV STRUCTURES TECHNOLOGY IMPACTS ON AIRFRAME STRUCTURAL EFFICIENCY

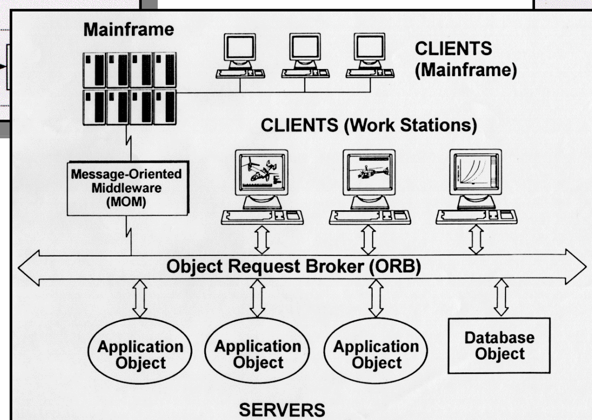


Technical Challenges to Reduced Cost

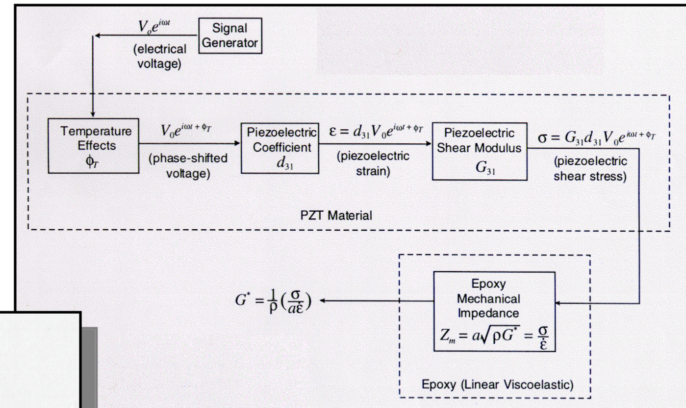




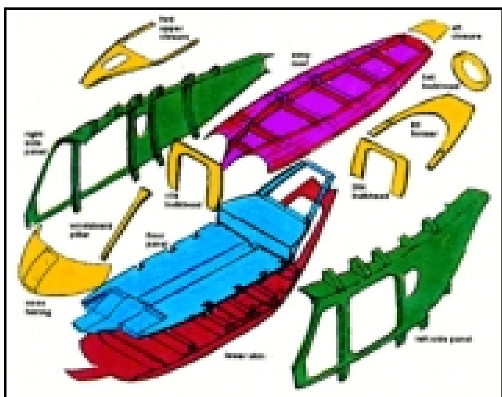
Rheological Measurement During Cure



Integrated Helicopter Design Tools



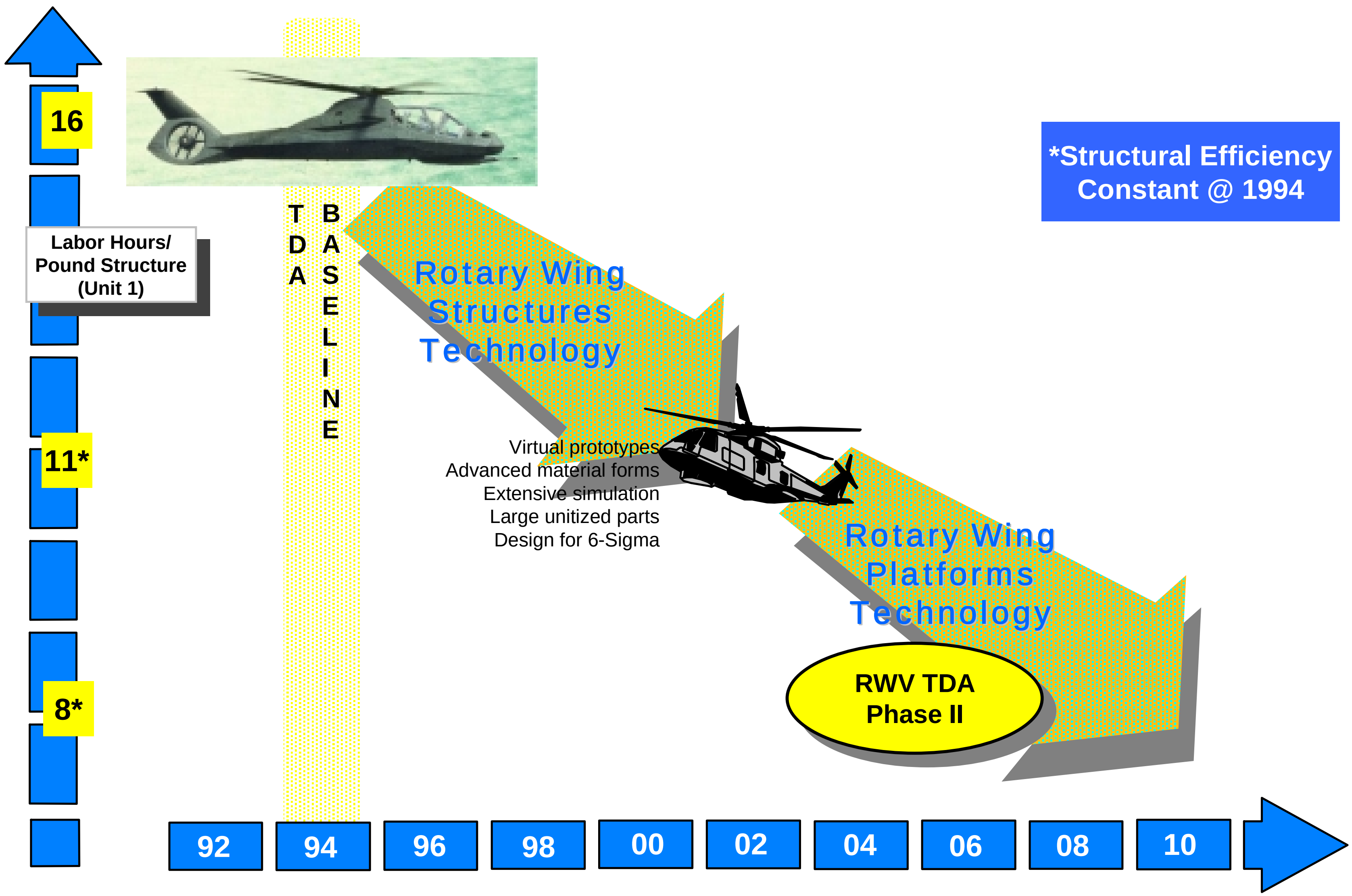
Adaptive Control of Cure Cycle



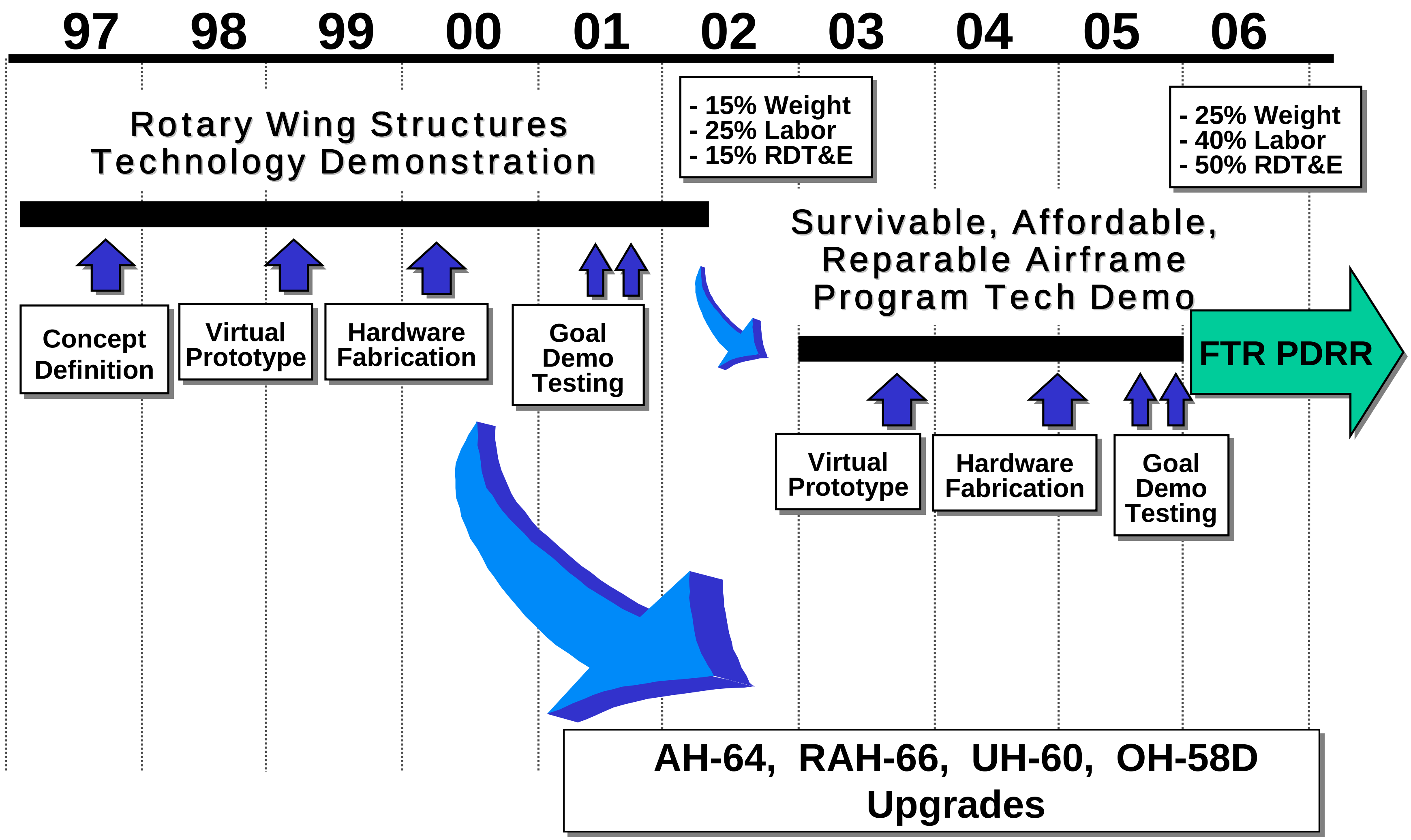
Simultaneous Fab/Assembly

Virtual Prototyping

RWV Structures Technology Impacts On Airframe Manufacturing Labor

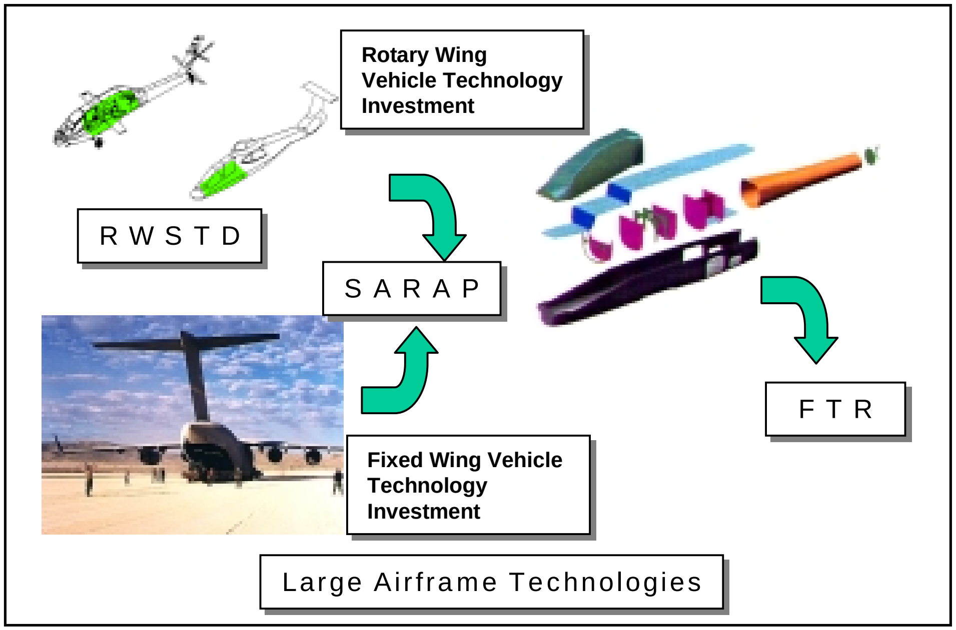


ROTARY WING STRUCTURES TECHNOLOGY EVOLUTION



MAJOR EFFORT: SURVIVABLE, AFFORDABLE, REPARABLE AIRFRAME PROGRAM (S A R A P)

Objective: Develop and demonstrate large airframe fuselage technology with reduction in weight and increased affordability to transition to FTR.



Goals

- 25% Weight Reduction
- 40% Increase Affordability
- 40% Reduction in development time
- Provide ballistic tolerance, crash safety

Improves Payload Capacity 28%
Improves Range 54%

Airframe Technology:

- Dynamically Tailored Smart Structure
- Crashworthy
- Ballistic Tolerant to AAA & MANPADS
- Pressurized
- Durable/Supportable

TECHNOLOGY BARRIERS
RWV STRUCTURES

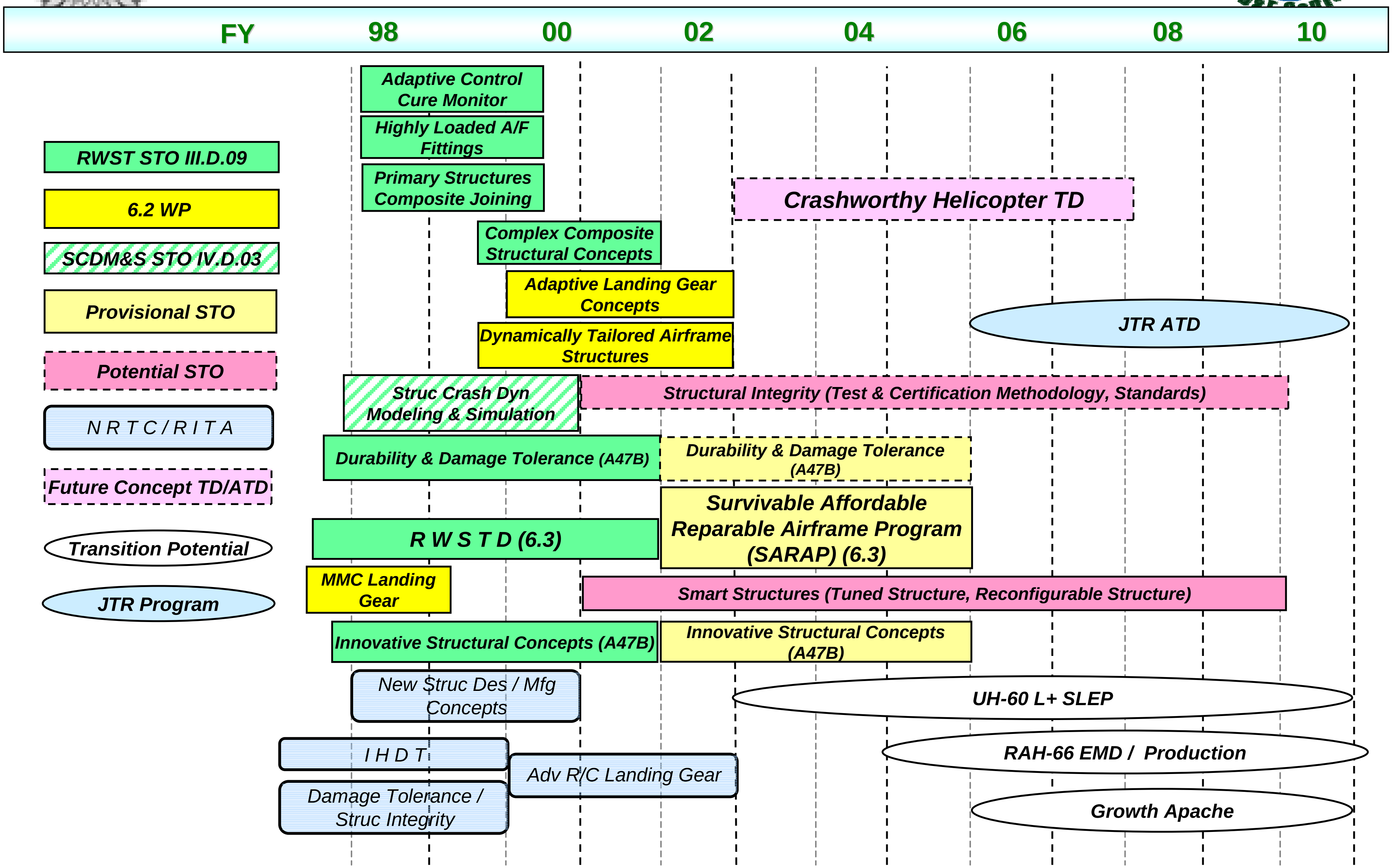
Technology Barriers – Airframes			
JTR Capability Needed	**Current Technology**	**Technical Barrier**	**Technology Solution**
		Affordability	
Five man-hours / pound T1	11 man-hours / pound T1	• Component Fabrication and Assembly	Process feedback and control Unitized structures
On-condition maintenance / Field assessment and capability	Phased inspection / no repair methods	• Damage Characterists	HUMS Damage tolerance criteria
Rapid inspection / Common repair methods	Manual inspection / no repair methods	• Depot Inspection and Repair	Deterministic NDE ?
- - -	+ / - 25%	Accurate Loads Prediction	Non-linear analysis methods
		Dynamic Structural Tailoring	
Stability at high L/D	Stability at low L/D	• Wing	Design optimization
Adaptive frequency response and attenuation	Single frequency optimization	• Fuselage	Adaptive structures
Zero margin design	Critical path design	Structural Optimization	Fiber tailoring & orientation/ Design optimization
	Daily / Phased inspection & repair	Durability / Structural Integrity	Integrated HUMS / SUMS
High strain allowables	Reduced allowables / toughened resins / crack detection	• Rugged Concepts and Materials	“Z” reinforcement
Joint Structural Design philosophy and certiviation	Safe Life – Army Damage Tolerance – AF, Navy	• Damage Tolerance / Safe Life Methodologies	Unified design and certification standards
Crash energy system management	High weight fraction landing gears	Crashworthiness @ high Gross Weight	Adaptive landing gears Crashworthy fuselage design
30mm tolerant	Fuel bladders (no requirement)* Redundant load paths	Hydrodynamic Ram (wet wing)* Tougher materials	Leverage fixed-wing technology / Textiles, Z-reinforcement
Pressurized Fuselage*	None	Fuselage Sealing Methods	? / Leverage fixed-wing technology

* Configuration dependent

TECHNOLOGY RISK ASSESSMENT RWV STRUCTURES

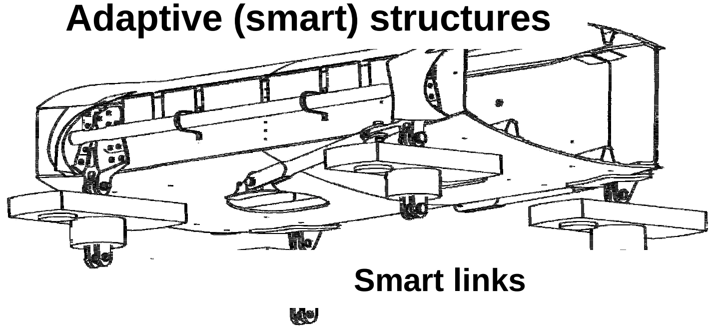
Technology Solution	Risk Assessment
Process feedback and control Unitized structures	G
HUMS Damage tolerance criteria	Y
Deterministic NDE	R
Non-linear analysis methods	Y
Design optimization	G
Adaptive structures	Y
Fiber tailoring & orientation/ Design optimization	G
Integrated HUMS / SUMS	Y
“Z” reinforcement	G
Unified design and certification standards	R
Adaptive landing gears Crashworthy fuselage design	Y
Textiles, Z-reinforcement	Y
Leverage fixed-wing technology	Y

RWV STRUCTURES TECHNOLOGY ROADMAP



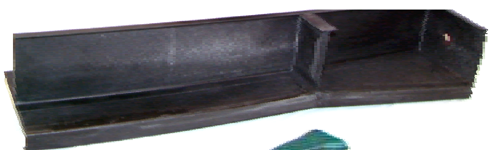
SARAP Key Component Technologies

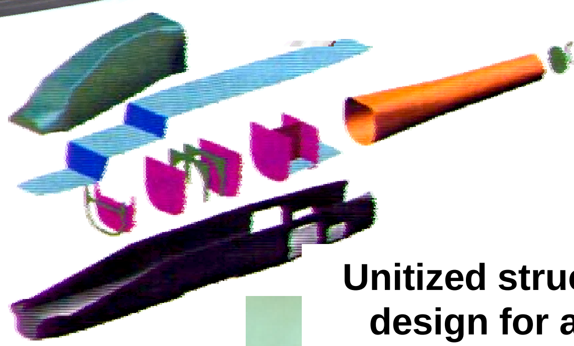
Adaptive (smart) structures



Smart links

Electron beam cure





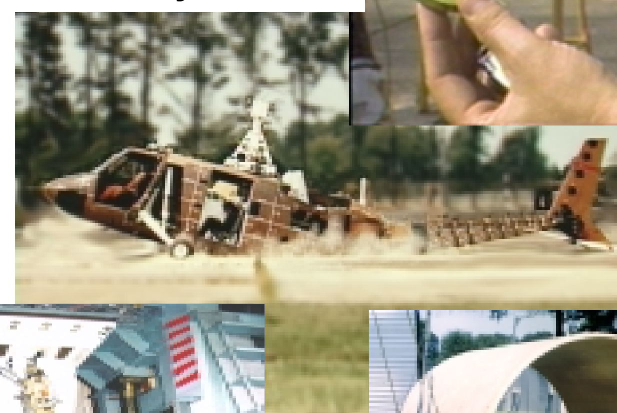
Unitized structures and design for assembly

Z-pinned truss core

Primary bonding

Improved fitting designs

Survivability



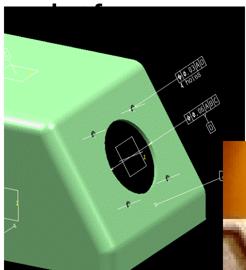
Adaptive landing gears

Crashworthy fuselage

Survivable, Affordable, Reparable Airframe Program (SARAP) w/o Competition

PRODUCTS:

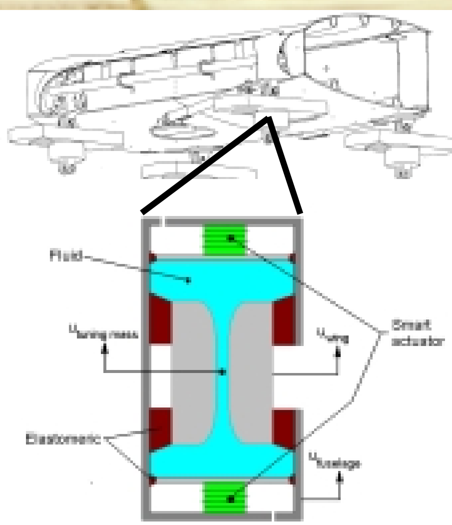
- Configuration independent technology maturation
- Configuration dependent flying TD on legacy platform
- Validated virtual prototype
- Tech transition to baseline legacy



ManTech (CAI Phase III)
- $4M + $4M cost share
Industry cost share (30%)
RM&S possibility

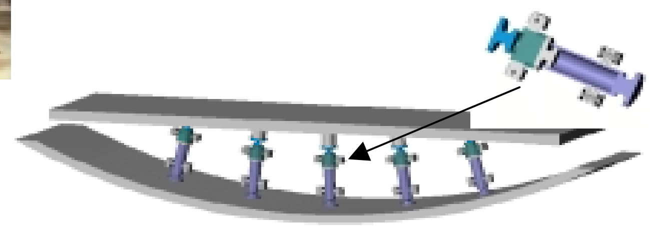
LEGACY FLEET BENEFITS:

- Low / No risk modernization of legacy platform
  - CH-47 or
  - CH-53 / UH-60 or
  - V-22 / MV-22



CHARACTERISTICS:

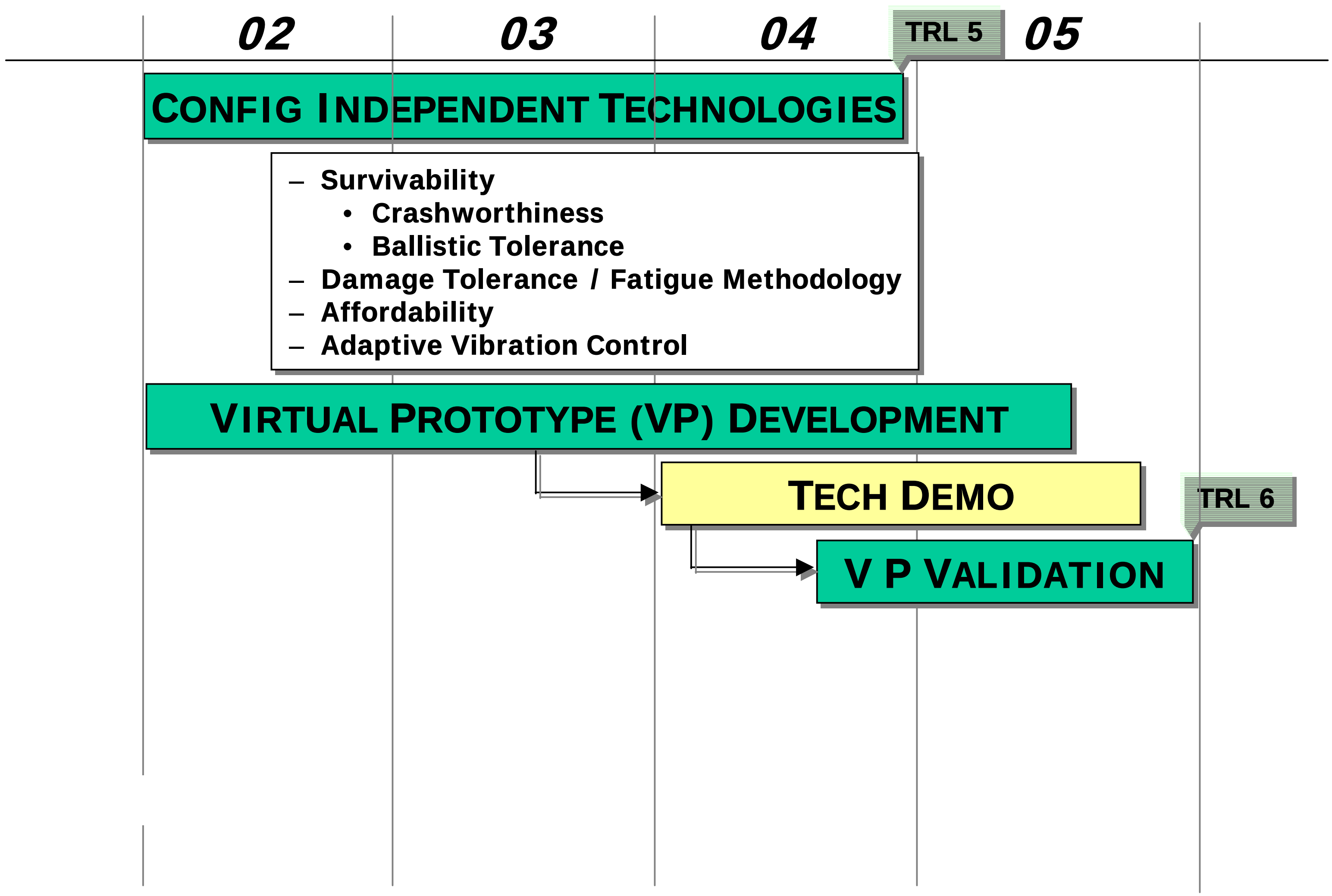
- Competitive source selection, single TD
- Hardware demonstrated in one of two fashions:
  - Non-flying subassemblies
  - Flying subassemblies on legacy test-bed
- Both configuration specific and non-specific demonstrations
- Scaleable virtual prototype validation
- TDA Phase III technology objectives



FTR BENEFITS:

- Risk mitigation of common FTR technical barriers
- Scaleable virtual prototype validated for rapid application to FTR ATD
- Contributes 25% of FTR leap-ahead capabilities

Survivable, Affordable, Reparable Airframe Program (SARAP)



Phase III TDA Structures Payoffs